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ABSTRACT

The report describes the development and field testing of the Early Social-Communication Scales (ESCS), a measure intended to reflect developmental dimensions of the at-risk infant's and toddler's adaptive interactions. The ESCS was designed to assess three major communicative functions (social interaction, joint attention, and behavior regulation) and to be conceptually linked to the sensorimotor/cognitive stage model. Results revealed substantial validation from the cross-sectional data analysis in conjunction with an adapted version of the Uzgiris-Hunt Scales. The social and cognitive measures were found to be relatively independent of such non-cognitive factors as age and level of motor development. It is asserted that such a model can be used to predict learning readiness. (CL)

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Final Report

OSE Grant No. - G007802091

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THE RELATIONSHIP BETWEEN SENSORIMOTOR DEVELOPMENT AND COMMUNICATION IN THE YOUNG SEVERELY HANDICAPPED CHILD

March 1982

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Special Education Programs

Author's Abstract

The purpose of the research was three-fold: 1) to develop a measure to assess early social/communication skills; 2) to evaluate the validity of the cognitive stage model used to link the scales conceptually to the sensorimotor/cognitive domain; and 3) to explore communication training strategies derived from the model as a foundation for an empirically-based curriculum. Research methods included a synthesis of the literature on the development of early cognitive, social, communicative and linguistic skills. This synthesis and the cognitive stage model guided construction of a set of social-communication scales. Repeated cross-sectional assessments with these scales and a cognitive measure were conducted with a heterogeneous sample of at-risk and mildly to severely handicapped children. This generated a data base for examining the scales' reliability and the theoretical model's validity, through correlational and regression analyses. Finally, experimental training studies based on predictions from the cognitive stage model were piloted.

In addition to a preliminary draft of the scales and evidence for their reliability across several conditions, the research produced strong support for the theoretical model. Results demonstrate that the social and cognitive measures are highly inter-correlated across samples, relatively independent of non-cognitive factors, including age and level of motor development. Results of training pilots suggest that the model can predict learning readiness and is useful in identifying conceptual prerequisites to training targets. The research, by validating aspects of the cognitive stage model, provides a valuable comprehensive framework for organizing assessment and intervention activities related to early social, cognitive and communicative development.

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Jeffrey M. Seibert, Ph.D.

Mailman Center for Child Development
University of Miami

Miami, Florida

March 1982

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Preface

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Introduction

As outlined in the original proposal, a major objective of this research project was to develop empirically-based scales of early social-communication development that encompass prerequisites and explore relationships with the sensorimotor/cognitive domain. A second major objective was to explore training strategies for communication development which can provide the foundation for an empirically-based curriculum. The communication instrument should be a useful diagnostic tool as well as a valuable aid for determining intervention objectives for individual children and for monitoring progress in the young mildly to severely handicapped child. In carrying out this research, a third objective was identified: validation of the theoretical model used to organize scale construction and curriculum development.

There is a growing body of literature, primarily with young non-handicapped children, on the relationship between developments in the communication and cognitive domains. Determination of prerequisites to the development of communication skills provides essential information to the interventionist who is concerned with developing these skills in developmentally delayed youngsters. Our research objectives were motivated by a perceived need to make this theoretical and empirical information accessible to the interventionist while, at the same time, extending that knowledge base. Before discussing our specific research plan and our findings, background on what available theoretical and empirical information guided our efforts provides an important perspective.

For development during the first two and a half years of life, several recent studies attempt to articulate and test a general stage or competence model to characterize the infant and young toddler's cognitive achievements. (Fischer, 1980; Uzgiris, 1976, 1977; McCall, Eichorn & Hogarty, 1977; Wachs & Hubert, 1981). The consensus in this and related literature (e.g., Bates, 1976; Snyder, 1978; Sugarman-Bell, 1978) is that the competence model should account for diverse developments related both to object-oriented and social-communicative skills. The proposed stage model is derived from Piaget's (1952, 1954, 1962) description of the six stages of the sensorimotor period, modified to four stages (five, including an initial reflex level). Uzgiris' (1976) characterization of the four stages includes a level of simple, voluntary, but undifferentiated actions (2-7 months), followed by a level of complex, differentiated but relatively inflexible action patterns (7-13 months). Fairly sophisticated trial-and-error sensorimotor intelligence emerges at the next level of regulation-by-differentiated-feedback (13-21 months). The transition into symbolic rather than sensorimotor intelligence occurs at the final stage of anticipatory regulation (21-30 months).

Empirical support for the five-stage competency model is suggestive at best. Uzgiris (1976) discovered periods of diverging and converging skill acquisition across the Uzgiris & Hunt (1975) Scales (an instrument to assess Piagetian sensorimotor abilities) in a sample of infants followed longitudinally. McCall et al (1977) reanalyzed the longitudinal Berkeley Growth Study data, using a principal components analysis on the item pool at monthly intervals

and computing cross-age correlations over time. They found instability of cross-age correlations at ages when the items comprising the principal components shifted in qualitative ways. McCall's description and age ranges for each stage are strikingly similar to Uzgiris'. Kagan, Kearsley & Zelazo (1978) report patterns of shifting correlations at similar ages for a sample of children assessed on a different set of cognitively-based measures.

Wachs and Hubert (1981) used factor analytic techniques to analyze the structure of cognitive performance on the Uzgiris-Hunt Scales in samples of 14, 18, and 22 month old infants and found first components at each age that correspond to Uzgiris' last three stages.

An obstacle to validation of competence models is the lack of a well-articulated theory of structural relatedness. The best source is Fischer's (1980) theory, which postulates what relatedness is a function of and how it can be evaluated. According to Fischer, behaviors that require control over the same or very similar sets of skills are more likely to develop in synchrony than behaviors that reflect a similar general structural level but that tap dissimilar sets of specific skills. Behaviors at different levels should not develop in synchrony. Unfortunately, determination of what skills are components of a particular behavior is not always a simple matter of behavioral task analysis. Analysis at a more abstract, conceptual level is often required. Fischer's theory predicts that behaviors that require control over similar sets of skills are more likely to develop in synchrony because their acquisition depends on similar kinds of experiences. However, even less related skills at the same structural level are likely to develop in synchrony if equal opportunity for their acquisition is made available. In general, this means that one can evaluate global relatedness between behaviors by providing equal opportunities for experience for acquisition of both behaviors. In addition, this suggests that, if one of the related behaviors is present in the individual's repertoire, it indexes the presence of the necessary structure to acquire the other behavior, if opportunity for experience is provided. However, experience should be effective only if structure and the prerequisite component skills, determined by conceptual task analysis, are in the repertoire.

Wohlwill's (1973) method of change pattern analysis, although proposed as an observational rather than an experimental intervention strategy, makes a similar assumption about structural relatedness. One begins by matching a group of children for the same level of performance on an ordinal-scale dimension. One then either observes changes over time or trains to induce change on that dimension. Following a specified period of time or training, one then examines the degree of correlation between number of items mastered on the target dimension and pre-test performance on a separate, presumably related, dimension. It is very likely in a large sample that different subjects are at varying levels of performance on the second dimension at pre-test (a function both of different optimal levels and different opportunities for experience), although matched for level of performance on the target dimension. If a relationship exists between dimensions, individuals higher on the hypothesized related dimension will progress further on the targeted dimension. Statistically, this means a significant positive correlation between level of pre-test performance on the related dimension and number of items mastered on the target dimension. The stronger and more reliable the correlation, the stronger the presumed

relationship between dimensions.

Two points may be apparent from this discussion. First, since structure and experience are each necessary but not sufficient for the acquisition of behaviors, highly consolidated, stage congruent development (structures d' ensemble) across all related domains is not a prediction of the model (Fischer & Bullock, 1981). Developmental decalages are expected. Peak performances reflect optimal structural levels. Behaviors at even higher levels will not be trainable until further development occurs. Different individuals at the same optimal level will typically display different behavioral profiles as a function of their particular opportunities for experience. The reports in the literature (e.g., Uzgiris, 1976) of low stage congruence and low interscale correlations at specific ages are consistent with this framework. Second, structure, diagnosed through the presence of behaviors that index that level of organization, implies only the potential to acquire other behaviors at that level and not their automatic appearance in the individual's repertoire. The role of experience as well as structure in behavioral acquisition provided the rationale for the training study pilots. It also makes the research relevant to intervention concerns.

Training studies can also be used to test whether certain behaviors are prerequisite to other behaviors. Without the hypothesized components, training on a target behavior should be ineffective. Training studies represent the only kind of approach that can determine whether typically observed ordinal sequences, either within or across developmental dimensions, represent sequences of prerequisite behaviors. A behavior typically preceding a second behavior in development may be a prerequisite, but it may also be coincidentally related. Opportunity to master the behaviors may typically occur earlier for the first behavior, but if opportunities were reversed, the sequence might reverse. Only a training study can evaluate the validity of alternative explanations, by controlling for opportunities for experience.

However, training studies alone provide only one of the pieces of data to validate a competency or stage model. Patterns of acquisition among broader ranges and constellations of behavior must also be examined for ordinal sequences and periods of transition and consolidation. Ideally, longitudinal data are gathered to address these concerns, but in their absence, cross-sectional data from large samples of children at different developmental levels can provide at least partial answers. The examination of patterns of relationships among developments in different behavioral domains can provide important information about typical vs. structurally necessary relationships among behavioral domains.

In defining the content of the two domains of interest in our research efforts, we looked to what instruments have already been developed in the sensorimotor/cognitive domain. A number of Piagetian instruments for this period have been developed (e.g., Escalona & Corman, unpublished; Casati & Lezine, 1968), but the best known and most readily available in published form is the set of scales developed by Uzgiris and Hunt (1975). Their scales have been used widely for both theoretical and practical purposes (Uzgiris & Hunt, in press; Seibert, in press). The aspects of early cognitive development represented by the six scales include object permanence, understanding of means-ends relationships, gestural and vocal imitation, understanding cause-effect relationships, object relations in space, and schemes (consistent behavioral patterns) for acting on objects. The published Uzgiris-Hunt scales, however, are not organized into distinct stages or levels that cut across the different scales.

For the social-communication domain, in contrast, a comparable set of scales was not available. We therefore turned to the relevant research literature to develop and define our categories of early social and communication development. Among the earliest efforts in the literature are Bowlby's (1969, 1973) and Ainsworth's (1968) research and theorizing on the development of attachment. Their framework proposes that behaviors indicative of the child's emerging attachment to his caregiver also reflect his level of cognitive development.

The more recent writings of Bates and her colleagues (Bates, Benigni, Bretherton, Camaioni & Volterra, 1979), Sugarman-Bell (1978) and Snyder (1978) seek the origins of communicative functions in the prelinguistic gestural system of the developing infant and explore how the transition to early words is accomplished. In addition, these investigators have examined how the various social-communicative developments relate to more traditional sensorimotor developments. Nelson (1974) has proposed an influential theory regarding early object reference. She hypothesizes that the child's early concepts for objects, which provide the core of meaning to which names are attached, have their basis in the child's functional action patterns on objects. Bruner (1975a, b) has delineated important categories of mother-child interaction, such as joint activity and attention, social games and turn-taking routines. He argues that these interactions provide critical experiences for the development of communicative competencies underlying early language acquisition.

Theorists such as Halliday (1975) and Dore (1975) have proposed pragmatic categories that suggested a basis for organizing the social domain into distinguishable dimensions or scales. And other investigators (e.g., Miller, Chapman, Branston, & Riechle, 1978; Benedict, 1977; Macnamara, 1977; Brazelton, Koslowski & Main, 1977) have looked at specific components of interactive processes that have added important details to our analyses of the dimensions. With the perspective provided by a consideration of the approaches represented and the sources pooled in developing and implementing our research plan, we turn now to a consideration of our primary research methods.

Methods

Subjects: - Over 100 high risk and handicapped infants and toddlers have served as subjects in the research to be reported. They were accessible sometime during the past three years through their participation in a daily centered-based program of early intervention directed by the senior author. Some children who participated in the intervention project were excluded from the study. A minimal criterion for inclusion in the study was enough functional vision and motor ability to demonstrate successful reach and grasp for an object. A wide range of developmental levels is represented in the sample. Most analyses were conducted on 90 children, including 70 handicapped and 20 at-risk children. Means and standard deviations for chronological age (correcated for prematurity, when necessary) and for the developmental measures administered to each child are presented in Table 1 for this sample of 90 children for one of the series of analyses reported. These data are reported in order to give the reader an idea of the nature of the subject pool drawn upon in the various research efforts. For this group, fifteen of the twenty high risk children and thirty-two of the 70 handicapped children were male. Within the handicapped sample, sixteen had Downs' Syndrome; four had a visual impairment as their primary handicap; four had a hearing impairment; seven were emotionally disturbed, with accompanying mental retardation; five had significant physical handicapps (cerebral palsy, arthrogryposis); fourteen had multiple handicaps that include mental retardation and some physical or sensory impairment; and 20 others had some degree of retardation with various (e.g., hydrocephaly, anoxia, fetal alcohol syndrome) or unknown etiologies. The great majority of the children were from families of low socio-economic status.

Table 1

Means and Standard Deviations for High Risk and Handicapped Samples

		CA (Mos.)	Bayley PA (Mos.)	Bayley MA (Mos.)	Mean AUHS (level)	Mean ESCS (level)
High Risk n=20	Mean	22.25	18.65	20.00	3.08	3.01
	SD	8.17	6.85	7.22	.72	.60
Total Handicapped n=70	Mean	24.21	12.26	11.83	2.11	2.03
	SD	9.47	7.49	6.57	1.06	.95

Instruments:

At this initial phase, we used the general stage model to organize much of the behavioral content of both domains, through an adaptation of the Uzgiris-Hunt Scales (AUHS) and the construction of the Early Socical-Communication Scales (ESCS). The Uzgiris-Hunt Scales were modified by eliminating socially-interactive items (including the Imitation Scales) and assigning items from the five remaining scales to the previously noted five stage sequence. The elimination of social items reduces overlap between the two instruments, allowing relatively independent assessment of behavioral content.

Major test construction efforts were directed at the development of the Early Social-Communication Scales. The scales are intended to reflect developmental dimensions of the infant and toddler's adaptive interactions with persons during the first thirty months. A large body of research and theory noted earlier was reviewed in gathering behavioral content and constructing observational categories for the ESCS. This literature was integrated, in a reciprocal exchange, with insights derived from videotaped observations of our semi-structured interactions with project children. The item content was organized to complement the Uzgiris-Hunt Scales, using the same five-stage organization.

The ESCS is designed to assess three major communicative functions that develop during the first two years: Social Interaction, Joint Attention and Behavior Regulation. Social Interaction encompasses behaviors that have as their primary objective and function the establishment of attention to self, with no goal in mind except playful interaction between self and other. Joint Attention refers to interactions for which one communicative partner is attempting to direct the other partner's attention to an object, person or event. The primary purpose is sharing attention, that is, looking at the same thing together. At the higher levels, joint attention activities lead into linguistic communicative functions focused on information exchange, or shared attention about details of entities, events, and situations. Behavior Regulation includes behaviors for which one communicative partner is attempting to direct or regulate the other's behavior, typically to achieve an external goal. Often, behavior regulation occurs in the form of enlisting the assistance of another in order to have a need met. The goal of the interaction may also be either to restrict the activity or to elicit a compliant action from the partner. These dimensions have been further differentiated according to role distinctions relating to initiating, responding and maintaining (Behavior Regulation, however, does not include a maintaining scale). The Scales have undergone numerous revisions and re-organization of item content, with the intent of streamlining them and simplifying them for practical application. At the conclusion of the grant, major revisions in presentation of the administration procedures were anticipated to be needed before the instrument would be accessible to the practitioner or researcher.

1. Instrument Reliability

One of the major concerns, in order to use the scales for research purposes, was an evaluation of their reliability. An investigation of inter-rater, test-retest, inter-examiner, tester-teacher interview, and live rating vs. videotape rating reliabilities was conducted during the past year in order to extend the findings on reliability reported in last year's Progress Report. Six different trained testers/raters and twenty-eight children participated in the reliability

study. All sessions were videotaped and scored by two independent raters. For analyses of test-retest reliabilities, resolved scores, with discrepancies eliminated, were used for each testing session. Spearman rank order correlations were used to analyze the results.

2a. Validation of the Cognitive Stage Model - Cross-Sectional Studies

Concurrently with our investigation of ESCS reliability, we have evaluated the scales' construct validity and the validity of the competence or stage model underlying the organization of both insturments. Specifically, predictions related to structural relatedness, stage congruence, ordinality, periods of stage transition, and prerequisites have been investigated. The sample of 90 children described earlier was central in most of these analyses.

Each child was assessed on the Adapted Uzgiris-Hunt Scales (AUHS), the Early Social-Communication Scales (ESCS), and the Bayley Mental Scale, for construct validation, and the Bayley Motor Scale, as an index of level of motor development. Administration of the total test battery for a child was completed within three weeks.

The data for each child include chronological age, Bayley mental age and psychomotor age, a mean object level score for the AUHS and a mean social level score for the ESCS. The mean level scores are computed in the following way. For each scale from each cognitive assessment instrument, the highest level at which a child passes an item in a scale is the score the child receives for that scale. A mean level score is then determined for each child by computing the average level score for all the scales for that assessment instrument.

ESCS and AUHS test administrations were carried out independently for each child and rated without knowledge of performance in the other domain. Seven testers administrered the ESCS and seven testers administred the AUHS. Only three testers were trained on both instruments, but none administered both sets of scales to the same subject. All testing sessions for both sets of scales were videotaped and independently scored by two raters, neither of whom had information on the child's performance on the other assessment. Inter-rater discrepancies for both ESCS and the AUHS were resolved by recourse to the videotaped records of the testing sessions.

2b. Validation of the Stage Model - Training Studies

Two different types of training studies have been piloted. One type evaluates the model's validity in predicting learning readiness based on the structural relatedness hypothesis. The second type examines evidence for the necessary nature of hypothesized conceptual prerequisites to training targets. Because both of these studies are only pilots and have not been written up yet for publication, the theoretical rationale underlying the procedures will first be discussed at some length.

The model explicitly states what factors should determine whether a specific behavior will be present in an individual's repertoire. The model posits that the level of cognitive organization that the behavior implies and the presence of prerequisite component skills, together with appropriate opportunity for experience, are necessary for a child to exhibit a specific behavior. An individual lacking a specific behavior, therefore, must be lacking for one of several different reasons. He may not yet be at a complex enough general level of cognitive organization, regardless of opportunitity for experience; he may lack

specific prerequisite components; or he may simply have lacked adequate opportunity for experience to master the behavior, despite displaying the necessary cognitive organization and prerequisites. Training, that is, providing opportunities for appropriate experience, may be expected to be differentially effective as a function of the cause of the behavior deficit.

The critical question becomes how does one determine whether an individual has the necessary cognitive organization to acquire a behavior, if he lacks that behavior. Here is where the model's notion of shared cognitive organization underlying disparate behaviors becomes especially useful. If the individual demonstrates behaviors in other dimensions at a level of organization similar to that required for the targeted behavior, the model asserts that these behaviors indicate that he has the necessary cognitive structure to acquire the targeted behavior. On the other hand, if his repertoire reveals no behaviors at this level, the model predicts that training is not likely to be successful. Therefore, examining the individual's summary profile of performance across the various scale dimensions, and especially in what may be more closely related scale dimensions, (requiring control of similar skill sets) should provide the information needed to make a judgment about his potential to acquire the target behavior with training. Likewise, if immediate developmental prerequisites to a behavior can be identified (based on a conceptual task analysis), their presence or absence in the individual's repertoire should allow a prediction of whether he will benefit from training.

The first pilot study tested the model's prediction that the presence of related behaviors at the same structural level as the missing targeted behavior indexes availability of the structure needed to acquire the behavior. Subjects demonstrating related behaviors at the same or higher levels should be more likely to benefit from training on the target than subjects failing to demonstrate related behaviors at that level. This study employed the training adaptation of Wohlwill's method of change pattern analysis. Children were matched at the same level on a Self-Recognition scale; their improvement with training on several Self-Recognition tasks was correlated with their pre-test Object Permanence scores. The pilot study involved two small groups of children who could be matched for one of two levels on the Self-Recognition scale. All children were trained for a two week period on subsequent items in the Self-Recognition sequence above their ceiling level of performance. Data for analysis included number of items acquired through training.

The second pilot study tested the hypothesis that prerequisites to a behavior can be identified through conceptual task analysis and verified through training. Specific hypotheses are derived from patterns observed in both cross-sectional and longitudinal data, where one or more behaviors consistently precede another behavior in development. The temporal difference must not be so great as to make the sequence trivial. For both theoretical and empirical reasons, following another's gaze to the left or right and using objects in socially influenced ways were hypothesized to be prerequisites to the acquisition of receptive labels for objects. Subjects were identified and grouped according to whether they had one or both of the hypothesized prerequisites. All subjects then received structured training on receptive labels. The specific hypothesis was that only those with both components would benefit from training. Data to be analyzed were the number of children benefitting from training in the single or double prerequisite group.

3. Other Related Research

a. Another area of our research was concerned with the reconciliation of alternative approaches to cognition. We have examined the relationship between our competence model-based measures and a cognitive measure developed out of the information-processing tradition. Handicapped infants and toddlers were assessed on our developmental measures and on a repeated measure of visual recognition memory (visual preference for novelty). A mean novelty score can be computed for each subject based on the percent of time he distributes his total visual attention between pairs of stimuli, one of which he has had the opportunity to observe on previous trials and one of which is novel. This score was then correlated with the child's performance on the Bayley Scales, the AUHS, and the ESCS, all administered within a three week period of each other.

b. Longitudinal observations of a child born with arthrogryposis were also continued until the end of the research project and his departure to a public school program.

Results

1. Instrument Reliability

Although sample sizes are small for some of the conditions, the pattern of results indicates that the ESCS can be administered in a highly reliable fashion. Administration of the ESCS yields eight scale scores and a mean level score based on an average of the eight scales scores. Spearman's rank order correlation coefficient for inter-rater reliability for mean level scores is .93; for the individual scales, the inter-rater reliability coefficients range from .53 to .91, with a median of .84. For test-retest reliability at a one-week interval, the rank order correlation coefficients are .98 for mean level scores and range from .55 to .96, for individual scales, with a median of .89. Table 2 presents more details of these analyses. For the AUHS, inter-rater and test-retest reliabilities were determined for a smaller subset of the scores. The scales' reliability has already been demonstrated across a number of studies with different populations (e.g., Uzgiris & Hunt, 1975; Kahn, 1976). The analysis for inter-rater reliability for mean AUHS level produced a Spearman's rank order correlation coefficient of .98 ($n=41$; $p < .001$). An analysis of test-retest reliability for mean AUHS level yielded a correlation coefficient of .98 ($n=8$; $p < .01$). The results are impressive, considering the complexity of the scales and the extensive training required to learn to administer and score them. The number of testers/raters involved in gathering this data (six) adds further to the generalizability of the findings. An especially important finding of the reliability study was that live rates by testers were generally highly reliable with videotaped rates. This type of reliability is essential if the scales are going to be used effectively outside of research contexts.

2a. Validation of the Model - Cross-Sectional Studies

A very strong degree of relationship (Pearson r equal to or greater than .85 for all sub-samples), predicted by the model, is consistently observed between mean ESCS performance and mean AUHS performance. This pattern has been replicated for the total sample and all sub-samples representing the full developmental range spanned by the model. Sub-samples have been constructed according to various sampling strategies, including at-risk, Down Syndrome, total handicapped, and children with chronological ages greater than 30 months. Similar strong correlations are observed between these measures and mental age estimates from the Bayley Mental Scale. See results of these analyses in Tables 3, 4, 5, and 6.

According to the model, the observed relationship should be mediated by specifically cognitive factors and not by general developmental or experiential factors. This prediction is confirmed by the finding that, for some of the sub-samples, the correlation of the ESCS with either chronological age or psychomotor age from the Bayley Motor Scale was non-significant and near zero. These fluctuations had no effect on the observed correlations among the cognitive measures. In fact, when regression analyses were conducted to control for PA and CA, AUHS accounted for increasingly larger percentages of the variance in the ESCS scores for the more deviant samples (see bottom half of Tables 3, 4, 5, and 6).

Of course, correlations need not imply stage congruence, since one domain may consistently lead the other domain throughout development. Analysis of individual subject's patterns of scores are needed to verify the model's prediction of inter-domain correspondence. Several findings bear on this prediction.

Table 2

Reliability Data for the Early Social Communication Scales, including Inter-rater, Test-Retest, and Live Rate to Videotape Rate[1]

	Inter-Rater (n=56)[2]	Test-Retest[3] (n=28)	LIVE-VT[4] Wk 1 (n=12)	LIVE-VT[4] Wk 2 (n=19)
Mean ESCS Level	.93	.88	.89	.93
RSI	.74	.72	.84	.63
ISI	.83	.70	.94	.78
MSI	.54	.60	.84	.51
RJA	.87	.82	.89	.73
IJA	.85	.79	.92	.87
MJA	.76	.74	.94	.73
RBR	.91	.78	.91	.84
IBR	.90	.87	.78	.85

[1]All coefficients, reported as Spearman rank order correlations, significant at .01 level or better.

[2]56 different assessments, rated by pairs of raters from a pool of 6 trained raters.

[3]One week interval.

[4]Based on ratings of 5 different testers/raters.

Table 3

Results of Correlational Analyses Between All Measures and Summary of Hierarchical Multiple Regression/Correlation Analyses with Mean ESCS as Dependent Variable, for High Risk Sample (N=20)

Correlational Analyses for All Measures*

	CA	PA	MA	Mean AUHS
PA	.91			
MA	.97	.90		
Mean AUHS	.85	.87	.85	
Mean ESCS	.78	.76	.78	.93

*all correlations significant ($p < .001$)

Hierarchical Multiple Regression/Correlation Analyses with Mean ESCS Level as Dependent Variable

Independent Variable	Multiple R	Adjusted R^2	Change in Adjusted R^2
PA	.76	.56	.56
CA	.79	.58	.02
AUHS	.93	.84	.26

Table 4

Results of Correlational Analyses Between All Measures and Summary of Hierarchical Multiple Regression/Correlation Analyses with Mean ESCS as Dependent Variable, for Total Handicapped Sample (N=70)

Correlational Analyses for All Measures*

	CA	PA	MA	Mean AUHS
PA	.61			
MA	.63	.82		
Mean AUHS	.65	.77	.91	
Mean ESCS	.44	.62	.85	.89

*all correlations significant ($p < .001$)

Hierarchical Multiple Regression/Correlation Analyses with Mean ESCS Level as Dependent Variable

Independent Variable	Multiple R	Adjusted R^2	Change in Adjusted R^2
PA	.62	.38	.38
CA	.63	.37	-.01
AUHS	.91	.83	.46

Table 5

Results of Correlational Analyses Between All Measures and Summary of Hierarchical Multiple Regression/Correlation Analyses with Mean ESCS as Dependent Variable, for Handicapped Sub-sample with CA 30 Months or Greater (N=33)

	Correlational Analyses			
	CA	PA	MA	Mean AUHS
PA	.23			
MA	.29*	.65**		
Mean AUHS	.34*	.56**	.87**	
Mean ESCS	.12	.40*	.84**	.85**

*p < .05
**p < .001

Hierarchical Multiple Regression/Correlation Analyses with Mean ESCS Level as Dependent Variable

Independent Variable	Multiple R	Adjusted R^2	Change in Adjusted R^2
PA	.40	.13	.13
CA	.40	.10	-.03
AUHS	.87	.73	.63

Table 6

Result of Correlational Analyses Between All Measures and Summary of Hierarchical Multiple Regression/ Correlation Analyses with Mean ESCS as Dependent Variable for Handicapped Sub-sample with Absolute Difference Between MA and PA of at least 4 months (N=29)

	Correlational Analyses			
	CA	PA	MA	Mean AUHS
PA	.35*			
MA	.35*	.55**		
Mean AUHS	.05	.54**	.85**	
Mean ESCS	.08	.26	.81**	.87**

*p < .05
**p < .001

Hierarchical Multiple Regression/Correlation Analyses with Mean ESCS Level as Dependent Variable

Independent Variable	Multiple R	Adjusted R^2	Change in Adjusted R^2
PA	.26	.04	.04
CA	.26	.00	-.04
AUHS	.91	.81	.81

When each subject's mean level of performance on the ESCS was compared with his mean level of performance on the Uzgiris-Hunt Scales, the distribution of individual difference scores between the two means was found to be symmetric, with the mode clearly at zero, that is, no difference (see Figure 1). Over two-thirds of the subjects had mean scores for the two instruments within one-half stage of each other.

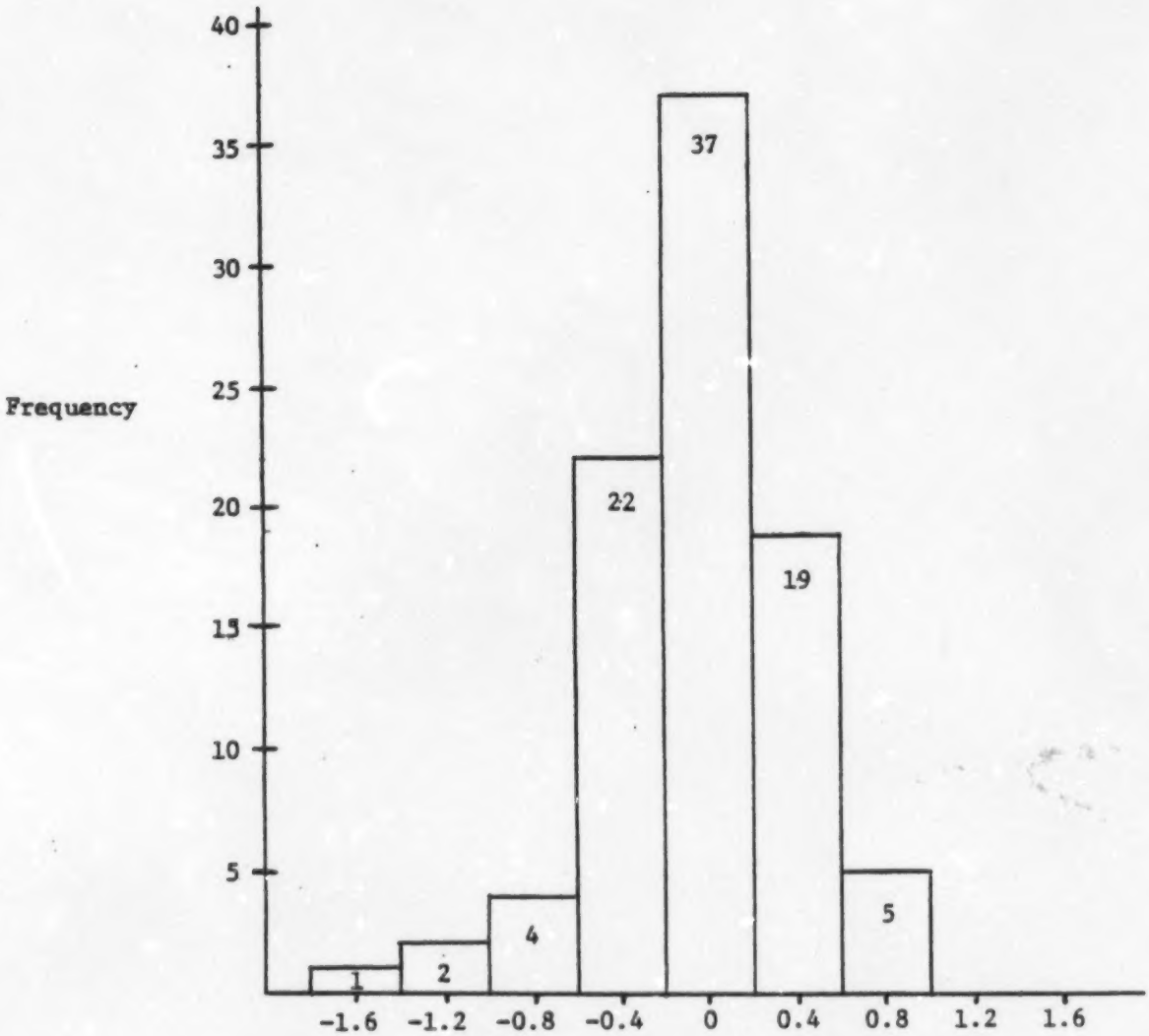
Another approach to the question of stage congruence between domains involved partitioning the total subject pool into groups according to MA level. Mental age ranges were established based on the age estimates provided by Uzgiris (1977) and McCall (1978) for each of the stages. In addition to the question of stage congruence, this analysis bears on predictions about stage ordinality and approximate developmental ages for each of the cognitive stages. The four groups included 2 to 7 month MA's (Level 1), 8 to 13 month MA's (Level 2), 14 to 21 month MA's (Level 3), and 22 to 30 month MA's (Level 4). Analyses examined the pattern of median levels for all of the scales within each MA group and compared changes in median levels across groups. For all but the last MA group, the median score for nearly every scale from both the ESCS and the Uzgiris-Hunt Scales corresponded to the level assigned by Uzgiris and McCall for that MA range. So, for example, for the 2-7 month MA group, all of the Uzgiris-Hunt Scales and all but one of the ESCS scales had a median score of 1, as the model predicts. The increases in level scores across MA groups occurred in an orderly ordinal and statistically significant fashion (see Table 7).

Another analysis, related to the model's hypothesis about stage transitions, examined the distribution of scale scores by level at each monthly mental age. The percentage of the total number of scale scores that reflected each of the five levels was computed at each month and then plotted. The resulting graph revealed a predicted increase in the percentage of each subsequent level score with increasing mental age and corresponding declines in the percentage of lower level scores with increasing MA. Most interestingly, transition points, when the stage value of the majority of scale scores shifted to the next stage, occurred at MA's corresponding to two of the transitional ages reported by Uzgiris and McCall. Specifically, the transition from level 1 scores dominant to level 2 scores dominant occurred between MA's of 7 and 8 months. The transition from level 2 to level 3 occurred between MA's of 12 and 13 months. However, no clear cut single transition point occurred for the shift from level 3 to level 4. The transition was accomplished by MA 25-26 months, later than the model predicts. Insufficient data for MA's of less than 2 to 3 months made an investigation of this transition point impossible. The pattern in these very limited cross-sectional data, a partial confirmation of the model's predictions based on empirical data from normal infant and toddlers, is striking when one considers the very small number of subjects representative of any single MA level in this analysis. The failure to observe a transition point between levels 3 and 4, of course, requires further empirical and conceptual analyses (e.g., errors in item level assignment for level 4).

2b. Validation of the Model - Training Studies

Results for the initial training study, on structural relatedness between Self-Recognition and Object Permanence, were suggestive. In one group (n=8), matched for one level of Self-Recognition performance, a positive trend (r=.60) was found between pre-test scores on Object Permanence and number of Self-Recognition items mastered; for the second group (n=11), matched for a different Self-

Figure 1: Distribution of Differences between Mean ESCS Level and Mean AUHS Level (n=90)



Individual Differences between Mean ESCS Level and Mean AUHS Level in .4 Stage Intervals (Positive difference indicates higher ESCS score)

Table 7

Mean, Median, and Range of ESCS and Sensorimotor Performance Across four Mental Age Developmental Levels[a]

Variable	Group 1 N=28 MA 2-7 mos.			Group 2 N=26 MA 8-13 mos.			Group 3 N=49 MA 14-21 mos.			Group 4 N=24 MA 22-30 mos.		
	Mean	Med.	Range	Mean	Med.	Range	Mean	Med.	Range	Mean	Med.	Range
MA	5.0	5.0	2-7	10.4	10.5	8-13	17.7	18	14-21	25.8	24.5	22-30
PA	6.0	6.5	2-14	9.4	9.0	6-17	18.1	18	8-27	23.4	25.5	9-30
CA	16.7	18.5	4-35	19.1	19.0	11-30	27.4	28	14-39	31.5	31.5	25-38
Sensorimotor												
Object Permanence	0.9	1.0	0-3	2.3	2.0**	1-4	3.68	4.0**	2-4	4.0	4.0	4-4
Means-Ends	1.0	1.0	0-3	2.2	2.0**	1-3	2.86	3.0**	2-4	3.3	3.0*‡	2-4
Causality	0.8	1.0	0-2	1.5	1.5**	1-3	2.91	3.0**	1-4	3.3	3.5**	0-4
Space	1.0	1.0	0-2	1.8	2.0**	1-3	3.20	3.0**	2-4	3.6	4.0**	3-4
Schemes	1.2	1.0	0-2	2.1	2.0**	1-3	3.09	3.0**	2-4	3.4	3.5	2-4
ESCS												
RSI	1.5	1.5	1-3	2.2	2.0**	1-3.5	2.7	3.0**	2-3.5	3.3	3.5*	2-4
ISI	1.2	1.0	0-3	2.1	2.0**	0-3.5	2.9	3.0**	1-4.0	3.1	3.0	1-4
RJA	1.4	1.0	1-2	2.2	2.0**	1-3.5	3.1	3.0*	1-4.0	3.8	4.0**	3-4
IJA	0.9	1.0	0-3	2.1	2.0**	0-3.5	3.1	3.0*	1-4.0	3.6	4.0**	1-4
RBR	1.2	1.0	0-2	2.1	2.0**	1-3.5	3.2	3.5**	2-4.0	3.5	3.5**	3-4
IBR	1.2	1.0	0-3	2.2	2.0	1-3.5	3.1	3.0**	2-4.0	3.6	4.0**	3-4

[a]Some statistics based on smaller sample sizes due to missing data.
*p < .025 **p < .005

‡Significant differences may result even if median value does not change between groups.

Recognition level, the relationship (r=.36) was positive but non-significant. Including other measures (e.g., Means to Desired Ends) in the analysis may improve the predictive power of the pre-test variables. Alternatively, it may be that Object Permanence scores are better predictors of learning potential for Self-Recognition at one level than at the other.

If the same dimensions are likely to be related in varying degrees at different levels, as these results suggest, caution will need to be exercised in selecting dimensions at those levels when the relationship is likely to be strongest. Conceptual task analyses are useful for these decisions.

Results for the second training study, unfortunately, were more equivocal. Too few of the subjects benefited from training to reach any definite conclusion, although no subject lacking either prerequisite benefitted. Apparently, the hypothesized prerequisites are necessary for receptive label acquisition, but are developmentally still too remote (develop earlier) to function as immediate prerequisites. A re-analysis of the cross-sectional data, coupled with several assessment pilots conducted this past spring, indicated that even more advanced skills in the prerequisite dimensions always emerged prior to receptive labels and that these later skills may in fact index the hypothesized immediate prerequisites. The model has helped identify two heretofore unrecognized prerequisites to the acquisition of early object names, but further research is needed to verify more immediate necessary components.

3. Other Related Research

a. When the relationship between visual recognition scores and performance on the cognitive and social developmental measures was evaluated, a consistent moderate relationship across two samples was observed. The visual recognition scores were also correlated with mental age, assessed by the Bayley (see Table 8). However, when attempts are made to predict performance on the developmental measures with level of motor development partialled out, visual recognition scores contributed to a significant increase in the amount of variance accounted for with only the ESCS. From this we concluded that the ESCS is a stronger test of cognitive (information-processing) abilities, independent of motor ability, than either the Adapted Uzgiris-Hunt Scales or the Bayley Mental Scale.

b. The longitudinal observations of the child with congential arthrogryposis (fusion of elbow, wrist, knee and ankle joints, severely restricting range of motion, gross motor and manipulation skills) have concluded on a high note. By the end of the project, the child, who had evidenced major delays in social-communication and object cognitive development, reached age level in his language development, as measured by the standardized Sequenced Inventory of Communication Development (Hedrick, Prather & Tobin, 1975). Videotaped records of his developmental progress remain to be scored, but the results will be summarized for publication. They add a new dimension to the information available on the development of severely handicapped but cognitively intact infants and toddlers.

The results of these various project components have been reported at various conferences and written up as chapters and journal articles for a number of different publications. Table 9 lists the various conference presentations of the research supported by this proposal. Table 10 lists publications and papers in press or submitted for publication that report on the results of the research project and their intervention implications.

Table 8

Correlations of CA, MA, PA, the AUHS, and the ESCS with Mean Recognition, Mean Study Time, and Novelty Responses on each Stimulus Pair in Samples 1 and 2[a]

	Sample 1						Sample 2					
	$\overline{X}$REC	CA	MA	PA	AUHS	ESCS	$\overline{X}$REC	CA	MA	PA	ESCS	
Study	-.27	-.16	.10	.09	-.03	-.18	-.23	.01	-.10	-.29	-.46*	
Pair 1	.73**	-.06	.09	.25	.35	.23	.59**	.01	.06	.04	-.09	
Pair 2	.67**	.15	.40	.38	.48*	.59**	.87**	-.27	.42*	.30	.54**	
Pair 3	.41	-.21	-.15	-.18	.12	.07	.42*	-.02	.45*	.48*	.70**	
							Pair 4 .20	.01	.21	.16	.21	
$\overline{X}$REC		.08	.30	.37	.58**	.59**	$\overline{X}$REC		-.15	.51*	.44*	.64**
CA			.62**	.62**	.47*	.43	CA			.29	.46*	.11
MA				.89**	.90**	.69**	MA				.91**	.70**
PA					.80**	.56*	PA					.77**
AUHS						.78**						

[a]The direction of correlation was not predicted for all pairs of variables; therefore, two-tailed analyses were employed.

*$p < .05$
**$p < .01$

Table 9

Conference Presentations during Grant Period

J.M. Seibert, Fourth Annual Boston University Conference on Language Development, Boston, September 1979.

J.M. Seibert and A.E. Hogan, Sixth Annual AAESPH Conference, Chicago, October 1979.

J.M. Seibert, Tenth Annual Interdisciplinary Conference on Piagetian Theory and the Helping Professions, Los Angeles, February 1980.

J.M. Seibert and K.G. Scott, Thirteenth Annual Conference on Research in Mental Retardation and Developmental Disabilities, Gatlinburg, Tennessee, March 1980.

A.E. Hogan, J.M. Seibert, and P.C. Mundy, Fifth Annual Boston University Conference on Language Development, October 1980.

J.M. Seibert and A.E. Hogan, Annual Convention of the American Speech-Language-Hearing Association, Detroit, November 1980.

J.M. Seibert, First Annual University of South Florida Symposium on Infant Communication, St. Petersburg, Florida, March 1981.

P.C. Mundy, J.M. Seibert, A.E. Hogan, and J.F. Fagan, Fourteenth Annual Conference on Research in Mental Retardation and Developmental Disabilities, Gatlinburg, Tennessee, March 1981.

J.M. Seibert, Fifty-ninth Annual International Convention of the Council for Exceptional Children, New York, April 1981.

J.M. Seibert, A.E. Hogan, and P.C. Mundy, 1981 Biennial Meeting of the Society for Research in Child Development, Boston, April 1981.

Table 10

Publications and Manuscripts
Produced by Research Project

Seibert, J., and Oller, K. Linguistic pragmatics and language intervention Strategies. Journal of Autism and Developmental Disorders, 1981, 11, 75-88.

Seibert, J.M. Use of the scales of psychological development in early intervention programs. In I.C. Uzgiris & J.McV. Hunt (Eds.), Research with scales of psychological development in infancy. Urbana, IL: University of Illinois Press, in press.

Seibert, J.M., & Hogan, A.E. A model for assessing social and object skills and planning intervention. In D. McClowry & S. Richardson (Eds.), Infant communication: Development, assessment and intervention. New York: Grune & Stratton, in press.

Seibert, J.M., Hogan, A.E., & Mundy, P.C. Developmental assessment of social-communication skills for early intervention: Testing a cognitive stage model. In R.A. Glow (Ed.), Advances in behavioral measurement of children. Greenwich, Conn: JAI press, in press.

Mundy, P.C., Seibert, J.M., Hogan, A.E., & Fagan, J.R. Recognition memory and cognitive assessment in young developmentally delayed children. Intelligence, in press.

Seibert, J.M., Hogan, A.E., & Mundy, P.C. Assessing interactional competencies: the Early Social-Communication Scales. Infant Mental Health Journal, in press.

Scott, K.G., and Hogan, A.E. Methods for the identification of high-risk and handicapped infants. To appear in C. Ramey, P. Trohanis, and R. Meyer (Eds.), Finding and educating the high-risk and handicapped infant. Baltimore: University Park Press, in press.

Mundy, P.C., Seibert, J.M., & Hogan, A.E. Measuring the early communication abilities of young developmentally delayed children. Submitted for publication to Merrill-Palmer Quarterly.

Seibert, J.M. The development of pre-linguistic communication skills: A neo-Piagetian analysis based on levels of cognitive organization. Submitted for publication in Piagetian Theory and the Helping Professions, Vol. IV.

Hogan, A.E., Seibert, J.M., & Mundy, P.C. The emergence of object labels in developmentally delayed toddlers: Implications for intervention and for a theory of early reference. Paper presented at the Fifth Annual Boston University Conference on Language Development, Boston, October 1980, being revised for publication.

Seibert, J.M. A model for analyzing the development of early communication skills, based on levels of cognitive organization. Paper presented at the Fourth Annual Boston University Conference on Language Development, Boston, September 1979.

Table 10, Cont'd

Hogan, A.E. A review of research employing the infant psychological development scales as developed by Uzgiris and Hunt, with normal and handicapped children. Unpublished manuscript, Mailman Center for Child Development, University of Miami, Miami, Florida, 1979.

Seibert, J.M. Developmental assessment for early intervention. Testing a cognitive stage model. Mailman Center for Child Development Technical Report, University of Miami, Mailman Center for Child Development, Miami, Florida, 1981.

de la Vega, M. Curriculum implications of the ESCS. Unpublished manuscript, University of Miami, Mailman Center for Child Development, Miami, Florida, 1981.

Conclusions

In terms of the orginial research objectives, the project has been successful. An instrument to assess early social and communication skills, conceptually linked to the sensorimotor/cognitive domain, has been developed and administered to over 100 at-risk and handicapped infants and toddlers. The theoretical model, used to guide the construction of this instrument and link its organization to the organization of an adapted version of the Uzgiris-Hunt Scales, has received substantial empirical validation from the cross-sectional data analyses. The scales appear useful for describing the social and communication skills of at-risk and handicapped infants and toddlers with a variety of disabilities. The training studies provide additional support for the structural relatedness hypothesis of the stage model. A preliminary draft of a curriculum, based on the stage model, has been developed to serve as a guide to future curriculum construction efforts.

One of the major theoretical and empirical contributions of our research, we would assert, is that it has used the available stage or competence model to organize behaviors a priori in order to test for specifically predicted relationships. Previous research has gathered data first and then imposed the the competence model, in post hoc fashion, on the patterns in the data. Such a descriptive approach is of course a necessary first step in articulating the competence model. However, with a model available, it should be used to generate specific predictions that are then subjected to empirical test, as our research has attempted to do.

The competence model we have adopted has proven to be a fruitful source of empirically testable hypotheses. Results lend strong support to the validity of the stage model for birth to thirty months. Nevertheless, the limitations of these data must be acknowledge. Most of the research has employed a cross-sectional design. Although cross-sectional data sheds some light on ordinality and patterns of transition and consolidation in development, there is no substitute for the detail on changing patterns in skill acquisition provided by longitudinal observations of the same subjects over extended periods of time. Cross-sectional data, frozen as they are at single points in time for single subjects, do not provide information on patterns of dynamic change. To evaluate the stage model's predictions about sequences and patterns of change in development, or invariant order and consolidation, tracking the progress of a sample of normal and handicapped infants from shortly after birth will be essential. In addition, further training studies are needed to test functional and prerequisite relationships.

From a practical perspective, the reported research has investigated behavioral domains that are central to early development. Early social-communication and cognitive developments provide basic tools for all further behavioral acquisitions leading toward self-sufficient activity. Research that increases our theoretical understanding of the processes underlying and inter-relating these domains can have substantial impact on interventions arranged for handicapped children. The research bears on practical concerns related to determining sequences of training targets, selecting objectives for which training is likely to be effective, and developing intervention packages that maximize intervention by focusing efforts simultaneously on multiple, structurally interrelated skills. Our long term objective is to provide a theoretical and empirical information-base for making

intervention decisions that, in the past, have been based only on best guesses and unsupported theoretical biases.

Although the research project has formally come to a close, the project has generated a wealth of data that remains to be explored. It has also suggested lines of further research that should contribute simultaneously to theory and practice. The project has been a good beginning because it has laid a sound theoretical foundation, grounded in data, for future research.

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